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(54) Abstract Title
Motor vehicle with deformable means between brake pedal and master cylinder

(57) The brake pedal 13, 213, substantially rigid, is pivotally connected to part of the body structure 12, 14 of the motor vehicle to supply an input of desired braking effort to the master cylinder 10 via a mechanical linkage operatively connecting the pedal to the master cylinder 10.

The mechanical linkage includes a deformable means 16 arranged to collapse a pre-determined amount when a load above a pre-determined limit is applied to it so as to absorb energy but maintain the linkage. The linkage comprises push-rods 17, 18, one entering the head of the other; when a high load is applied, the head is expanded by axial movement of the other rod 18. Alternatively, a push-rod engages a deformable tubular part on the pedal. A further construction, has a push rod 218 coupled to a bow-shaped beam 217 welded at one end to the pedal 213. The beam 217 deforms laterally under high load. Alternatively, a lever welded to the pedal and coupled at its opposite end to the push-rod is deformable.

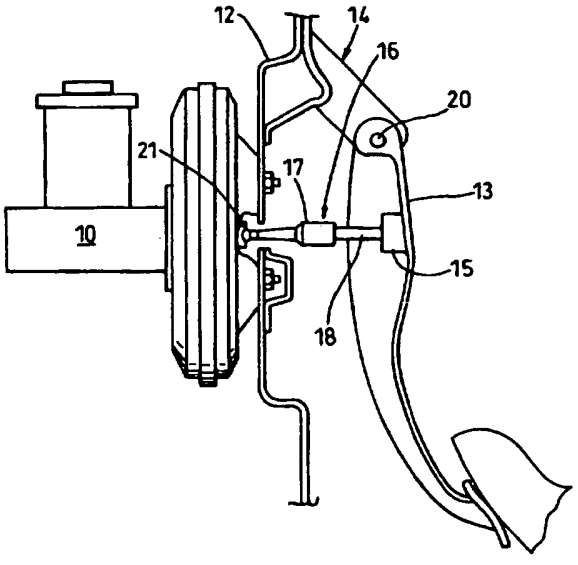

Fig. 1

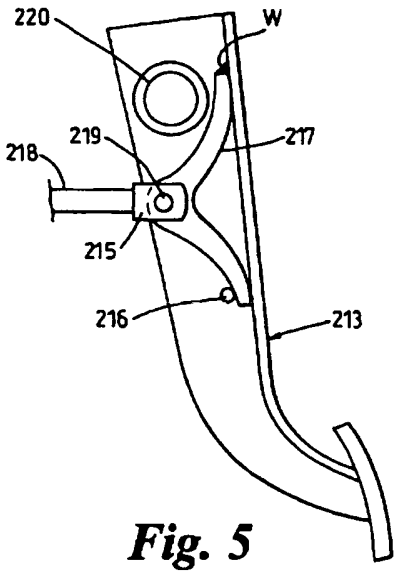

Fig. 5

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

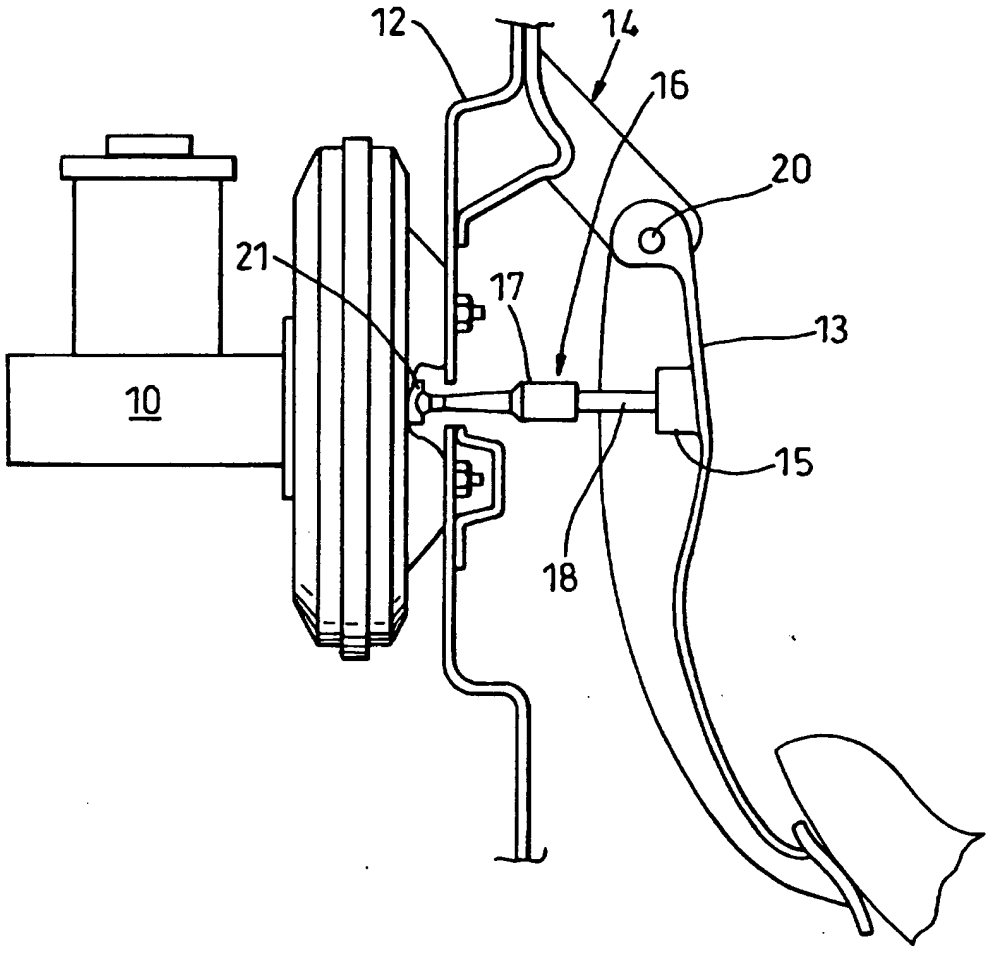

Fig. 1

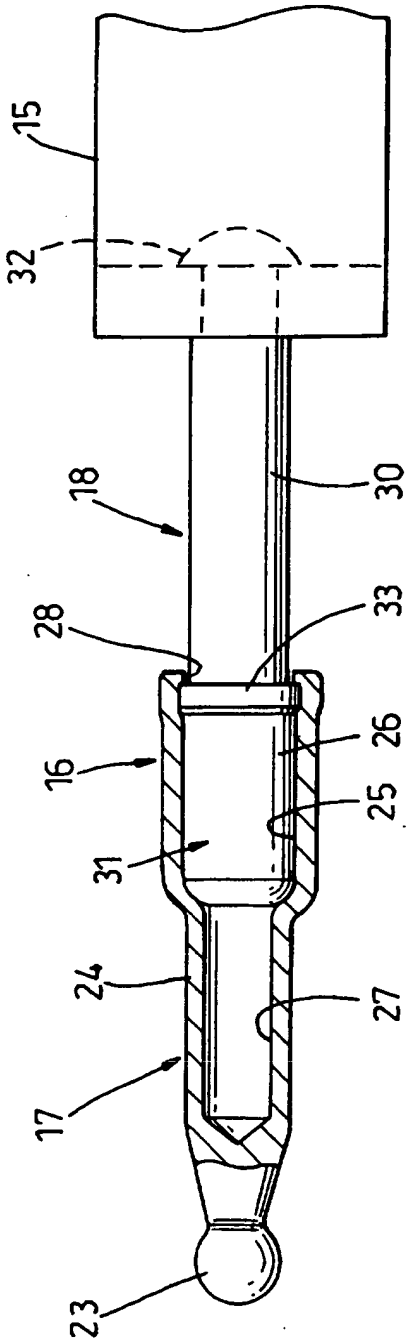

Fig. 2

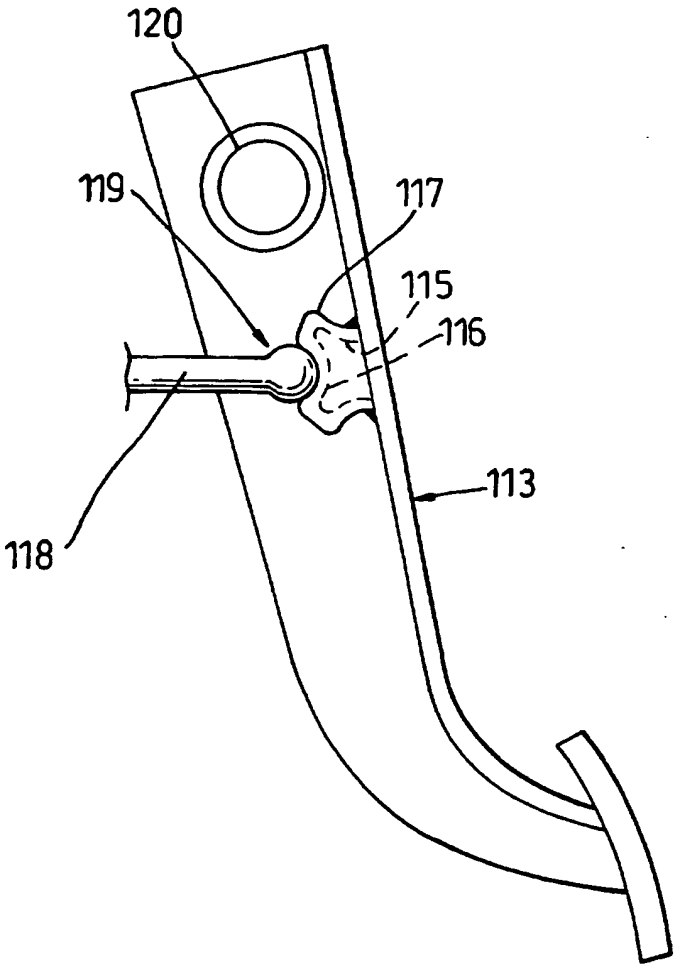

Fig. 3

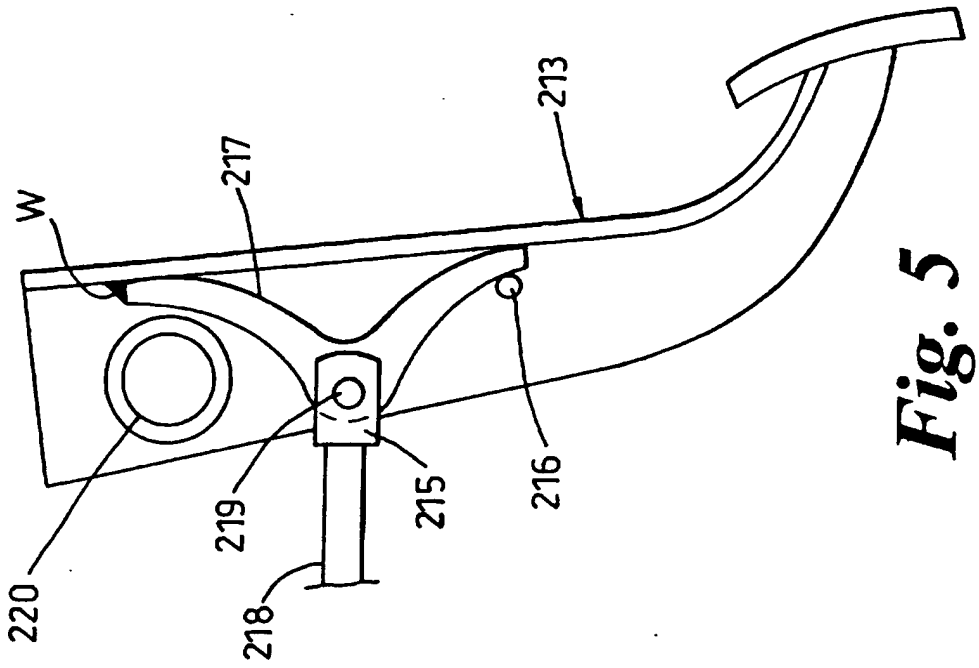

Fig. 5

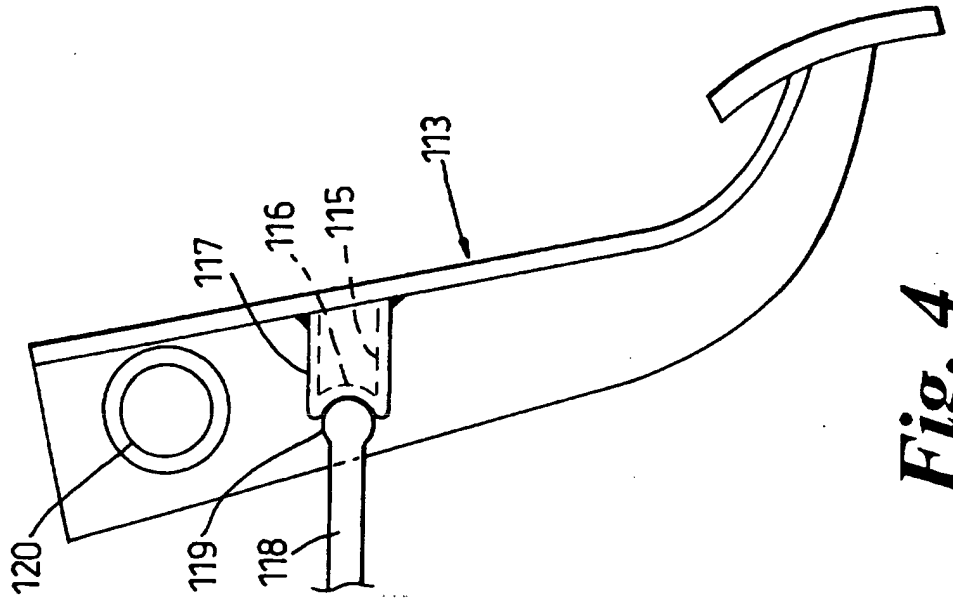

Fig. 4

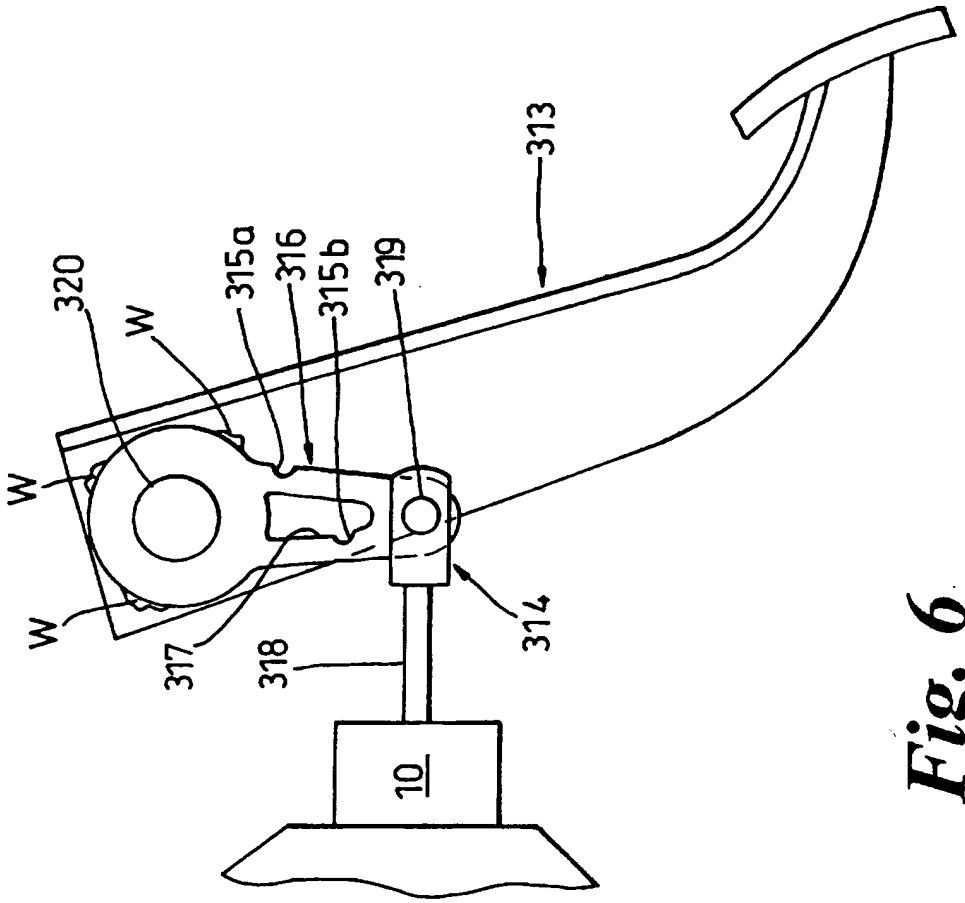

Fig. 6

A Motor Vehicle

This invention relates to a motor vehicle and in particular to an improved brake actuation mechanism for a motor vehicle.

It is well known to provide a motor vehicle with a hydraulic master cylinder connected to a bulkhead or firewall separating an engine compartment from a passenger compartment of a motor vehicle.

Such a master cylinder assembly is normally operated by a depending brake pedal which is pressed upon by an operator of the motor vehicle to apply the brakes of the motor vehicle.

It is a problem with such prior art arrangements that in the event of a serious frontal impact the operator is often applying a large load to the brake pedal and the force of impact tends to throw the driver forward increasing the pressure upon the foot and ankle.

To overcome this it has previously been proposed to disengage the brake pedal from the master cylinder assembly by some form of releasable coupling. Although such a solution may reduce injuries it has the disadvantage that once the linkage has broken no further braking effect can be produced.

It is an object of this invention to overcome the problems associated with the prior art.

According to the invention there is provided a motor vehicle having a body structure, an engine supported by the body structure to provide a source of motive power for the motor vehicle and a braking system for applying a braking force to the motor vehicle, the braking system including a master cylinder to supply fluid

at increased pressure to one or more brake means, a substantially rigid driver operable lever pivotally connected to part of the body structure of the motor vehicle to supply an input of desired braking effort to the master cylinder and a mechanical linkage operatively connecting the lever to the master cylinder wherein the mechanical linkage includes a deformable means arranged to collapse a pre-determined amount when a load above a pre-determined limit is applied thereto.

The deformable means may comprise first and second interengaged members, the first member having a bore with which the second member is engaged, wherein upon the application of an axial load greater than a pre-determined load to the two members, the two members are pushed into a further position of engagement thereby causing deformation of one of the two members.

The bore in the first member may be a cylindrical bore having a diameter in said further position that is less than the diameter of the second member thereby causing deformation of one of the members.

The tubular portion of the first member may be expanded by the engagement of the second member.

The second member may be a thin walled tubular member that is compressed by the further engagement with the first member.

The deformable means may include a tubular member that is acted upon by a rod, the tubular member being arranged to buckle when a load beyond a pre-determined level is applied to it by the rod.

The tubular member may have a cylindrical bore and may be closed off at one end by an abutment wall against which the rod acts, the abutment wall being urged into the cylindrical bore by the rod during collapse of the tubular member.

The deformable means may include a beam in abutment at two spaced apart locations with the driver operable lever and a rod engageable with the beam between said locations so as to cause bending of the beam when a load beyond a pre-determined level is applied to the beam by the rod.

The beam may be curved so that the abutment with the driver operable lever occurs towards opposite ends of the beam.

The beam may be fastened at one end to the driver operable lever.

The deformable means may be a lever acted upon by a rod, the lever being attached at one end to the driver operable brake pedal for rotation therewith.

The invention will now be described by way of example with reference to the accompanying drawing of which:-

Fig. 1 is a side view of part of a motor vehicle according to the invention showing a first embodiment of a deformable brake actuation means;

Fig. 2 is a cross-section through part of the brake actuation means shown in Fig.1;

Fig. 3 is a cross-section through a second embodiment of a deformable brake actuation means in a deformed state;

Fig.4 is a cross-section through the deformable brake actuation means shown in Fig.3 in a pre-deformed state;

Fig.5 is a side view of a third embodiment of a deformable brake actuation means; and

Fig.6 is a side view of a fourth embodiment of a deformable brake actuation means.

With reference to Figs.1 and 2 there is shown a master cylinder assembly 10 attached to part of the body structure of the motor vehicle in the form of a bulkhead 12.

A driver operable brake pedal 13 is pivotally connected at an upper end thereof by means of a pivot pin 20 to a bracket 14 fixed to the bulkhead 12.

The brake pedal 13 is operatively connected to the hydraulic master cylinder 10 by a mechanical linkage 16. The mechanical linkage comprises a first push rod member 17 for engagement with an end face of piston 21 of the hydraulic master cylinder 10 and a second push rod member 18 for engagement with an abutment 15 on the brake pedal 13.

The first and second members 17, 18 form a deformable means that allow a limited or pre-determined collapse of the connection between the brake pedal 13 and the master cylinder 10 when a load beyond a pre-determined level is applied to them.

With particular reference to Fig.2 it can be seen that the first push rod member 17 has a solid part-spherical head 23 for abutment with the piston 21 and a stepped tubular body portion 24.

The stepped body portion 24 has a stepped cylindrical bore 25 having a first larger diameter portion 26 and a further smaller diameter portion 27.

An outer end of the first portion 26 is swaged inwardly to form a lip 28 used to retain an end portion 31 of the second push rod member 18 in engagement with the first portion 26.

The second push rod member 18 has a shank portion 30 terminating at one end in the first end portion 31 and at the other end in a mushroom-shaped head 32 for abutment with the abutment 15 on the brake pedal 13.

A circumferential rib 33 extends around the end portion 31 at its juncture with the shank 30. The rib 33 co-operates with the swaged in lip 28 of the first push rod member 17 to hold the end portion 31 in engagement with the first portion 26 of the stepped bore.

The diameter of the first portion 26 of the stepped bore 25 is substantially the same as the overall diameter of the end portion 31 of the second push rod member 18.

The diameter of the further portion 27 of the stepped bore 25 is considerably less than the overall diameter of the end portion 31.

During normal operation of the brakes the difference in diameter between the end portion 31 and the further portion 27 is such that the first and second push rod members act as a rigid push rod. However, when the load applied to the two members 17, 18 exceeds a pre-determined level the end portion 31 will be pushed further unto the stepped bore 25 causing it to become engaged with the further portion 27 of the stepped bore 25. This causes the wall of the stepped tubular body portion 24 in the region of the further portion 27 to be stretched outwardly.

This process requires a considerable amount of energy to be expended but retains a mechanical linkage at all times between the brake pedal 13 and the master cylinder 10.

With particular reference to Figs.3 and 4 there is shown a second embodiment of the invention, a driver operable brake pedal 113 is pivotally connected at an upper end thereof by means of a pivot pin 120 to a bulkhead (not shown).

The brake pedal 113 is operatively connected to a hydraulic master cylinder (not shown) by a mechanical linkage comprising a push rod member 118 for engagement with an end wall 116 of a deformable member 117 attached to the brake pedal 113.

The first and second members 117, 118 form a deformable means that allow a limited or pre-determined collapse of the connection between the brake pedal 113 and the master cylinder when a load beyond a pre-determined level is applied to them.

The push rod member 118 has a part-spherical end portion 119 that bears against the end wall 116 of the deformable member 117. The deformable member 117 has a tubular side wall 115 forming a tubular portion that is designed to buckle when a load beyond a pre-determined level is applied to it.

As can best be seen with reference to Fig.3 when a load beyond a pre-determined limit is applied to the end wall 116 it is pushed into the tubular portion of the deformable member 117 causing the tubular portion to be swaged outwardly and buckled at the same time, in this way a considerable amount of energy is absorbed before the spherical end portion 119 contacts the rigid brake pedal lever 113.

With particular reference to Fig.5 there is shown a third embodiment of the invention, a driver operable brake pedal 213 is pivotally connected at an upper end thereof by means of a pivot pin 220 to a bulkhead (not shown).

The brake pedal 213 is operatively connected to a hydraulic master cylinder (not shown) by a mechanical linkage comprising a first member in the form of a push rod 218 connected by means of a pin 219 to a second member in the form of a deformable beam 217 attached at one end by a weld "W" to the brake pedal 213.

The first and second members 218, 217 form a deformable means that allow a limited or pre-determined collapse of the connection between the brake pedal 213 and the master cylinder when a load beyond a pre-determined load is applied to them.

The push rod member 218 has a clevis member 215 at one end to form in combination with the pin 219 a connection between the first and second members 217, 218.

The deformable beam 217 is in contact with the pedal 213 at two spaced apart locations that are positioned near to the distal ends of the beam 217. The beam 217 is not in contact with the brake pedal 213 between these two positions so as to allow it to bend when a load is applied.

A guide member 216 is provided to maintain contact between the end of the beam 217 that is not welded to the brake pedal 213 with the brake pedal 213.

During normal use the beam 217 is sufficiently rigid to prevent undue flexing which would cause lost pedal travel but when the beam 217 is subjected to an excessive load it bends in a non-elastic manner thereby absorbing a considerable

amount of en rgy before the push rod member 218 contacts the back surface of the substantially rigid brake pedal lever 213.

With reference to Fig.6 there is shown a fourth embodiment of a deformable brake actuation means.

A driver operable brake pedal 313 is pivotally connected at an upper end thereof by means of a pivot pin 320 to a bulkhead (not shown).

The brake pedal 313 is operatively connected to a hydraulic master cylinder (not shown) by mechanical linkage comprising a first member in the form of a push rod 318 connected by means of a pin 319 to a second member in the form of a deformable lever 316 attached at one end by a weld "W" to the brake pedal 313.

The first and second members 316, 318, form a deformable means that allow a limited or pre-determined collapse of the connection between the brake pedal 313 and the master cylinder when a load beyond a pre-determined level is applied to them.

The push rod member 318 has a clevis member 314 at one end to from in combination with the pin 319 a connection between the first and second members 316, 318.

The deformable lever 316 has an aperture 317 therein to reduce its strength in bending and is further weakened by the presence of notches 315a, 315b.

During normal use the lever 316 is sufficiently rigid to prevent undue flexing which would cause lost pedal travel but when the lever 316 is subjected to an excessive load it bends in a non-elastic manner thereby absorbing a considerable

amount of energy before the push rod member 318 contacts the back surface of the substantially rigid brake pedal lever 313.

The pre-determined load above which yielding of the deformable means may occur is in the range 1.5KN to 8.0KN, but preferably in the range 2.0KN to 4.0KN.

It will be appreciated that the brake pedal lever itself could be designed to yield but this is not considered to be as advantageous as the preferred methods described in detail above because it is more difficult to control the amount of deformation that is permitted to occur before a firm pedal is restored.

CLAIMS

1. A motor vehicle having a body structure, an engine supported by the body structure to provide a source of motive power for the motor vehicle and a braking system for applying a braking force to the motor vehicle, the braking system including a master cylinder to supply fluid at increased pressure to one or more brake means, a substantially rigid driver operable lever pivotally connected to part of the body structure of the motor vehicle to supply an input of desired braking effort to the master cylinder and a mechanical linkage operatively connecting the lever to the master cylinder wherein the mechanical linkage includes a deformable means arranged to collapse a pre-determined amount when a load above a pre-determined limit is applied thereto.

2. A motor vehicle as claimed in Claim 1 in which the deformable means comprises first and second interengaged members, the first member having a bore with which the second member is engaged, wherein upon the application of an axial load greater than a pre-determined load to the two members, the two members are pushed into a further position of engagement thereby causing deformation of one of the members.

3. A motor vehicle as claimed in Claim 2 in which the bore in the first member is a cylindrical bore having a diameter in said further position that is less than the diameter of the second member thereby causing deformation of one of the members.

4. A motor vehicle as claimed in Claim 3 in which the tubular portion of the first member is expanded by the engagement of the second member.

5. A motor vehicle as claimed in Claim 3 in which the second member is a thin walled tubular member that is compressed by the further engagement with the first member.

6. A motor vehicle as claimed in Claim 1 in which the deformable means includes a tubular member that is acted upon by a rod, the tubular member being arranged to buckle when a load beyond a pre-determined level is applied to it by the rod.

7. A motor vehicle as claimed in Claim 6 in which the tubular member has a cylindrical bore and is closed off at one end by an abutment wall against which the rod acts, the abutment wall being urged into the cylindrical bore by the rod during collapse of the tubular member.

8. A motor vehicle as claimed in Claim 1 in which the deformable means includes a beam in abutment at two spaced apart locations with the driver operable lever and a rod engageable with the beam between said locations so as to cause bending of the beam when a load beyond a pre-determined level is applied to the beam by the rod.

9. A motor vehicle as claimed in Claim 8 in which the beam is curved so that the abutment with the driver operable lever occurs towards opposite ends of the beam.

10. A motor vehicle as claimed in Claim 8 or in Claim 9 in which the beam is fastened at one end to the driver operable lever.

11. A motor vehicle as claimed in Claim 1 in which the deformable means is a lever acted upon by a rod, the lever being attached at one end to the driver operable brake pedal for rotation therewith.

12. A motor vehicle substantially as described herein with reference to the accompanying drawing.

The Patent Office

13

INVESTOR IN PEOPLE

Application No: GB 9902869.8 **Examiner:** Roger Binding
Claims searched: 1-12 **Date of search:** 8 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B7B (BEXB, BEXX, BSDA)

Int Cl (Ed.6): B60R 21/09; B60T 7/06

Other: Online WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2322836 A	(ROVER GROUP), see the embodiments of Figs 1 to 4 and page 2, line 4, to page 5, line 7.	1
X	GB 1229000 A	(VAUXHALL MOTORS), see page 2, lines 75 to 99.	1-4
X	WO 97/13666 A1	(ITT AUTOMOTIVE), see the embodiment of Figs 1 and 2	1-3
X	WO 97/06036 A1	(HS TECHNIK UND DESIGN), see the embodiments of Figs 7 to 10, 13, 14.	1
X	US 5632184 A	(CALLICUTT)	1, 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.